Understanding the Effects of Space Radiation on Living Organisms and its Implication for Astrobiology

Ionizing radiation is one of the most lethal factors facing living organisms outside of Earth's protective atmosphere. Survival in space or on other planetary bodies is dependent on limiting and repairing damage from ionizing radiation. Understanding the mechanisms of defense against ionizing radiation may also provide insights into how life evolved on Earth and possibly on other planets. This session will examine our understanding of the basis of tolerance to ionizing radiation in different cell types and ask:
1. What mechanisms are most effective in protection against ionizing radiation?
2. How do these mechanisms compare in bacteria, archaea, and higher organisms?
3. Is it possible to engineer the increase of cellular resistance to ionizing radiation?
4. What are the implications for survival of life on space journeys, on Mars and Europa, and on other heavenly bodies?

The answers to these questions will be explored from both molecular biology and astrobiology perspectives.

Space radiation and its implications for finding life elsewhere.

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The planetary environment around a star will be assaulted with various amounts of radiation, including solar and ionizing radiation. The amount and type varies with the type of star, distance from the star, time of day, and other variables. While some radiation is critical to life on earth, especially from 400-750 nm (so-called visible and photosynthetically active radiation), the effects of ultraviolet and ionizing radiation can be hazardous and even deadly. This is because life is based on organic carbon, which is susceptible to radiation damage.

Radiation regimes in our own solar system address specifically radiation in a solar system with a main sequence star. The possibility remains of planets around red dwarfs. Such stars are much smaller in mass than the Sun (between 0.5 and 0.08 M_{Sun}), and so their temperature and stellar luminosity are low and peaked in the red. Since red dwarfs comprise about 75% of all stars in the galaxy, the possibility of life on planets around red dwarfs has been examined (Tarter et al., 2007).

The possibility of life on planets around stellar remnants is a possibility only recently articulated (Planets around stellar remnants). Clearly radiation on such planets could also be a hindrance to the origin or evolution of life.

To understand the minimum envelope for life in these various radiation regimes, our only "data point" is life on earth. Thus, the tolerance of radiation-resistant organisms such as

Deinococcus radiodurans will be compared to measured or hypothetical radiation regimes elsewhere.

"Planets around stellar remnants", January 23-37, 2012, Arecibo, (Puerto Ric http://www.mpia-hd.mpg.de/PLANETS2012/program.htm)

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